P71

Study of the influence of technological factors on improving the efficiency of ferroelectrically hard piezoceramic material PCR-8, designed for operation in power modes

M.A. Marakhovskiy[1], A.E. Panich[1], M.V. Talanov[2], V.A. Marakhovskiy[1]

[1]*Scientific Design and Technological Bureau "Piezopribor", Southern Federal University, 344090, Rostov-on-Don, Russia*
marmisha@mail.ru

[2]*Research institute of Physics Southern Federal University, 344090, Rostov-on-Don, Russia*

At present, ferroelectric materials intended for working in high-field regimes cause great interest in piezoelectric instrument making. Along with high coefficients of electromechanical coupling, these materials have low dielectric losses, high mechanical quality factor which provides high efficiency of the emitter. Ferroelectrically hard piezoceramic materials are resistant to external influences and have a high temperature stability of the parameters, which allows them to be used in various devices, including those designed for extreme conditions (accelerometers, piezo motors, piezotransformers of power sources of onboard equipment) [1]. To date, commercial piezoceramic materials of various compositions (PZT-8, APC-840, APC-841, PCR-8 [2]) have been created. However, the increase in the functional parameters of ferroelectrically hard materials can be achieved not only by creating new chemical compositions, but also by improving the technology of manufacturing piezoceramics and optimization of technological regimes. Thus, it is important to study the influence of technological factors on the functional parameters of ferroelectrically hard piezoceramic materials. The aim of the work was to establish correlations between the technological regimes of sintering of the well-known ferroelectrically hard piezoceramic material PCR-8 and its functional parameters.

PCR-8 ceramics were produced by solid-phase synthesis and sintered in three different ways: by conventional ceramic technology (chamber furnace at atmospheric pressure), by hot pressing with uniaxial pressure and by Spark Plasma Sintering in vacuum with uniaxial pressure and direct current pulses.

The completeness of the sintering process of piezoelectric ceramics was evaluated by the results of X-ray phase analysis, microstructure images obtained on a scanning electron microscope and the values of the density of sintered piezoelectric ceramics determined by hydrostatic weighing.

As a result of the obtained data analysis, it was found that the use of hot pressing and spark plasma sintering technology contributes to an increase in the density (ρ) and transverse piezoelectric module (d_{31}) by 5 and 60%, respectively. Along with the increase in the main parameters, it was possible to reduce the sintering temperature of the piezoelectric ceramics by 250 °C.

Thus, in the course of the study it was possible not only to increase the efficiency and manufacturability of ferroelectrically hard piezoceramic material PCR-8, but also to reduce energy consumption in the manufacture of final products. As a result, the use of spark plasma sintering technology allows to expand the field of practical application of ferroelectrically hard piezoceramic material PCR-8, to increase the share of the finished product and reduce its cost.

1. V.V. Eremkin, V.G. Smotrakov, M.A. Marakhovskiy, et al. *Materials Science* **10**, 20 (2014).
2. A.J. Danziger, O.N. Razumovskaya, L.A. Reznichenko, S.I. Dudkina. *High-performance piezoelectric materials. Search optimization* (Rostov n/D: Paike), 96 (1994).